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Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (Previously Presented): A method of automatically focusing an imaging system on an object comprising:

using either a comparison between an image of a typical object and an image of the object created by the imaging system or an edge density in an image of the object and the comparison to determine an optimum focus position.

Claim 2 (Previously Presented): The method of Claim 1, wherein using an edge density in an image of the object comprises:

computing the edge density of each image of a set of images of the object; and

using a focus position corresponding to an image of the set having a greatest computed edge density as the optimum focus position.

Claim 3 (Previously Presented): The method of Claim 1, wherein using a comparison between an image of a typical object and an image of the object comprises:

applying a difference between a first focus position and a second focus position of the imaging system to a third focus position corresponding to the image of the object, such that the third focus position is adjusted to the optimum focus position, wherein the first focus position corresponds to a reference image of the typical object, and wherein the second focus position corresponds to an image of the typical object that closely matches the image of the object.

Claim 4 (Previously Presented): The method of Claim 1, wherein using either the comparison or the edge density and the comparison automatically accounts for warpage in the object.

Claim 5 (Previously Presented): A method of automatically focusing an imaging system on an object comprising:

using a first focus position corresponding to an image of the object created by the imaging system that has a greatest edge density as an optimum focus position for the imaging system; and

adjusting a second focus position corresponding to an image of the object by a difference between focus positions for a reference image of a typical object and an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object.

Claim 6 (Original): The method of Claim 5, wherein using a first focus position comprises:

creating a set of images of the object at a plurality of different first focus positions using the imaging system, wherein each image in the set is created at a different one of the plurality of first focus positions, such that each image has an associated first focus position; and

computing a density of edges for each image in the set.

Claim 7 (Original): The method of Claim 5, wherein adjusting a second focus position comprises:

creating a set of images of the typical object using the imaging system, each image in the set being created at a different one of a plurality of focus positions;

selecting the reference image from the set of images for the typical object, the reference image having a reference focus position;

creating an image of the object at the second focus position using the imaging system;

comparing the image of the object to images in the set of images of the typical object to find a closest matching image, the closest matching image from the set having a comparison focus position; and

determining a change in the second focus position from the difference between the reference focus position and the comparison focus position, the change being applied to the second focus position, the applied change providing the optimum focus position for the imaging system to image the object.

Claim 8 (Original): The method of Claim 7, wherein the reference image is selected comprising:

computing a density of edges for each image in the set; and

choosing the image from the set having the greatest computed edge density as the reference image.

Claim 9 (Original): The method of Claim 5, wherein using a first focus position and adjusting a second focus position each automatically account for warpage of the object and the typical object.

Claim 10 (Previously Presented): A method of determining an optimum focus position of an imaging system comprising:

creating a set of images of an object at a plurality of different focus positions using the imaging system, wherein each image in the set is created at a different one of the plurality of focus positions, such that each image has an associated focus position;

computing a density of edges for each image in the set; and

determining the optimum focus position for the imaging system, the optimum focus position being the focus position associated with the image having a greatest computed edge density,

wherein the object is a typical object that is representative of a class of objects containing an object to be imaged, the determined optimum focus position being a reference focus position for the representative object.

Claim 11 (Original): The method of Claim 10, wherein the computed edge density is a relative measure of edges in each of the images.

Claim 12 (Original): The method of Claim 10, wherein the edge density is computed using an edge density metric employing one of any gradient-based and any non-gradient-based edge detection and image processing methods

Claim 13 (Canceled).

Claim 14 (Previously Presented): The method of Claim 10, further comprising:

creating an image of the object to be imaged at an arbitrary focus position using the imaging system;

comparing the image of the object to be imaged to images in the set of images of the typical object to find a closest matching image, the closest matching image from the set having an associated comparison focus position; and

determining a difference between the reference focus position and the comparison focus position and applying the difference to the arbitrary focus position to provide the optimum focus position for imaging the other object with the imaging system.

Claim 15 (Original): A method of determining a change in focus position of an imaging system comprising:

creating a set of images of a first object using the imaging system, each image in the set being created at a different one of a plurality of focus positions, such that each image has an associated focus position, the first object being representative of a class of objects;

selecting a reference image from the set of images of the first object, the selected reference image having an associated first focus position;

creating an image of a second object at a second focus position using the imaging system, the second object being a member of the class of objects;

comparing the image of the second object to images in the set of images of the first object to find a closest matching image, the closest matching image from the set having an associated third focus position; and

determining a change in the second focus position to provide an optimum focus position for imaging the second object with the imaging system.

Claim 16 (Original): The method of Claim 15, wherein the change is determined comprising:

determining a difference between the associated first focus position and the associated third focus position; and

adjusting the second focus position by the determined difference, the adjusted second focus position being the optimum focus position.

Claim 17 (Original): The method of Claim 15, wherein the reference image is selected automatically comprising:

computing a density of edges for each image in the set; and

choosing the image from the set having a greatest computed edge density as the reference image.

Claim 18 (Original): The method of Claim 15, wherein the reference image is selected manually by an operator.

Claim 19 (Original): The method of Claim 15, wherein comparing comprises using one or more of a sum of an absolute value of a difference between pixels, a sum of a square of the difference between pixels, and a cross correlation.

Claim 20 (Original): The method of Claim 19, wherein comparing using the cross correlation comprises filtering the image prior to computing a correlation.

Claim 21 (Currently Amended): An imaging system having automatic focusing comprising:

an imaging subsystem that images an object;

a memory;

a computer program stored in the memory; and

a controller that executes the computer program and controls the imaging subsystem, wherein the computer program comprises instructions that, when executed by the controller, implement using an image of the object created by the imaging system to determine an optimum focus position, the determination being either an image comparison-based determination or an edge density-based determination and the image comparison-based determination, the image comparison-based determination comprising a comparison between an image of a typical object and an image of the object created by the imaging system.

Claim 22 (Previously Presented): The imaging system of Claim 21, wherein the instructions that implement the edge density-based determination comprise:

using a first focus position corresponding to an image of the object created by the imaging system that has a greatest edge density as an optimum focus position for the imaging system; and wherein the instructions that implement the image comparison-based determination comprise:

adjusting a second focus position corresponding to an image of the object by a difference between focus positions for a reference image of a typical object and an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object.

Claim 23 (Original): The imaging system of Claim 21, wherein the instructions that implement using the object image to determine the optimum focus position comprise computing an edge density of each image of a set of images of the object; and using a focus position corresponding to an image of the set having a greatest computed edge density as the optimum focus position.

Claim 24 (Original): The imaging system of Claim 21; wherein the instructions that implement using the object image to determine the optimum focus position comprise applying a difference between a first focus position and a second

focus position of the imaging system to a third focus position corresponding to the image of the object, such that the third focus position is adjusted to the optimum focus position, wherein the first focus position corresponds to a reference image of a typical object, the second focus position corresponding to an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being imaged being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object.

Claim 25 (Original): The imaging system of Claim 21 being an X-ray laminography system.

Claim 26 (Previously Presented): An imaging system with automatic focusing that images an object, the system having an imaging subsystem; a memory; and a controller that controls the imaging subsystem, the system comprising:

a computer program executed by one or both of the controller or an external processor, the computer program comprising instructions that, when executed, implement either an image comparison of an image of the object created by the imaging system to an image of a typical object in a set of images of the typical object or both of an edge density determination and the image comparison to determine an optimum focus position for imaging the object.

Claim 27 (Previously Presented): The imaging system of Claim 26, wherein the instructions of the computer program implement the edge density determination of an image, the edge density determination comprising computing an edge density of each image of a set of images of the object; and using a focus position corresponding to an image of the set having a greatest computed edge density as the optimum focus position.

Claim 28 (Original): The imaging system of Claim 26, wherein the instructions of the computer program implement the image comparison of an image, the image comparison comprising adjusting a first focus position used to create the image of the object by a difference between a second focus position corresponding to a reference image of a typical object and a third focus position corresponding to an

image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being imaged being a member of the class, the imaging system further creating the reference image and the closely matched image of the typical object.

Claim 29 (Original): The imaging system of Claim 27, wherein the instructions further implement the image comparison, the image comparison comprising creating an image of another object at an arbitrary focus position using the imaging system, the object being representative of a class of objects, the other object being a member of the class of objects; comparing the image of the other object to images in the set of images of the representative object to find a closest matching image, the closest matching image from the set having an associated comparison focus position; determining a difference between the optimum focus position and the comparison focus position; and applying the difference to the arbitrary focus position to provide a focus position that is optimum for imaging the other object with the imaging system.

Claim 30 (Original): The imaging system of Claim 26, further comprising an inspection subsystem that provides object inspection.

Claim 31 (Previously Presented): A method of automatically focusing an imaging system on an object comprising one or both of:

using a first focus position corresponding to an image of the object created by the imaging system that has a greatest edge density as an optimum focus position for the imaging system; and

adjusting a second focus position corresponding to an image of the object by a difference between focus positions for a reference image of a typical object and an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object,

wherein adjusting a second focus position comprises:

creating a set of images of the typical object using the imaging system, each image in the set being created at a different one of a plurality of focus positions;

selecting the reference image from the set of images for the typical object, the reference image having a reference focus position;

creating an image of the object at the second focus position using the imaging system;

comparing the image of the object to images in the set of images of the typical object to find a closest matching image, the closest matching image from the set having a comparison focus position; and

determining a change in the second focus position from the difference between the reference focus position and the comparison focus position, the change being applied to the second focus position, the applied change providing the optimum focus position for the imaging system to image the object.

Claim 32 (Previously Presented): The method of Claim 31, wherein using a first focus position comprises:

creating a set of images of the object at a plurality of different first focus positions using the imaging system, wherein each image in the set is created at a different one of the plurality of first focus positions, such that each image has an associated first focus position; and

computing a density of edges for each image in the set.

Claim 33 (Previously Presented): The method of Claim 31, wherein the reference image is selected comprising:

computing a density of edges for each image in the set; and

choosing the image from the set having the greatest computed edge density as the reference image.

Claim 34 (Currently Amended): An imaging system having automatic focusing comprising:

an imaging subsystem that images an object;

a memory;

a computer program stored in the memory; and

a controller that executes the computer program and controls the imaging subsystem, wherein the computer program comprises instructions that, when executed by the controller, implement using an image of the object created by the imaging system to determine an optimum focus position, the determination being ~~one or both~~ of either image comparison-based or edge density-based and image comparison-based,

wherein the instructions that implement the edge density-based determination comprise:

using a first focus position corresponding to an image of the object created by the imaging system that has a greatest edge density as an optimum focus position for the imaging system; and

wherein the instructions that implement the image comparison-based determination comprise:

adjusting a second focus position corresponding to an image of the object by a difference between focus positions for a reference image of a typical object and an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object.

Claim 35 (Currently Amended): An imaging system having automatic focusing comprising:

an imaging subsystem that images an object;

a memory;

a computer program stored in the memory; and

a controller that executes the computer program and controls the imaging subsystem, wherein the computer program comprises instructions that, when executed by the controller, implement using an image of the object created by the imaging system to determine an optimum focus position, the determination being ~~one or both of~~ either image comparison-based or edge density-based and image comparison-based,

wherein the instructions that implement using the object image to determine the optimum focus position comprise applying a difference between a first focus position and a second focus position of the imaging system to a third focus position corresponding to the image of the object, such that the third focus position is adjusted to the optimum focus position, wherein the first focus position corresponds to a reference image of a typical object, the second focus position corresponding to an image of the typical object that closely matches the image of the object, the typical object representing a class of objects, the object being imaged being a member of the class, the imaging system creating the reference image and the closely matched image of the typical object.